

We claim:

1. A juncture for changing direction of fuel flow in a high pressure fuel injection system that is adapted to provide high pressure fluid to an internal combustion engine, said juncture comprising:

a juncture body;

a first passage formed in said juncture body, said first passage having a first diameter and a longitudinal axis extending therethrough, said first passage including a groove positioned along a portion of said longitudinal axis; and

a second passage formed in said juncture body, said second passage having a second diameter, a central axis extending therethrough, and an opening, said opening of said second passage being provided in said groove of said first passage to allow fluidic communication between said second passage and said first passage.

2. The juncture of claim 1, wherein said groove peripherally circumscribes at least a portion of said first passage.

3. The juncture of claim 2, wherein said groove partially circumscribes said first passage and is crescent shaped.

4. The juncture of said claim 2, wherein said first passage is substantially circular in cross section and said groove is annular in shape, said groove having a groove diameter larger than said first diameter of said first passage.

5. The juncture of claim 1, wherein said groove has a dished curvature.

6. The juncture of claim 1, wherein said opening of said second passage is transversely offset in said groove so that said central axis of said second passage does not intersect said longitudinal axis of said first passage.

7. The juncture of claim 1, wherein said second passage is at least two second passages, each having an opening that is positioned in said groove.

8. The juncture of claim 7, wherein said at least two second passages are transversely offset in said groove.

9. The juncture of claim 7, wherein said at least two second passages are positioned in said groove opposite to one another.

10. The juncture of claim 1, wherein said juncture is made of an alloy steel comprising at least one of chromium, molybdenum, and vanadium.

11. The juncture of claim 10, wherein said alloy steel comprises by weight, up to 5.5% chromium, up to 1.5% molybdenum, and up to 1.0% vanadium.

12. The juncture of claim 10, wherein said alloy steel is treated through a heat treatment cycle to provide a hardened martensitic core.

13. The juncture of claim 10, wherein said alloy steel is gas nitrided to provide a surface with enriched nitrogen content and hard surface layer having residual compressive stresses.

14. The juncture of claim 1, wherein said high pressure fuel injection system includes a common rail, said juncture being provided in said common rail.

15. The juncture of claim 1, wherein said high pressure fuel injection system includes at least one high pressure pump, said juncture being provided in said at least one high pressure pump.

16. A common rail for providing high pressure fuel to fuel injectors of an internal combustion engine, said common rail comprising:

a common rail body;

a first passage formed in said common rail body, said first passage having a first diameter and a longitudinal axis extending therethrough, said first passage including a groove positioned along a portion of said longitudinal axis of said first passage; and

a second passage formed in said common rail body, said second passage having a second diameter, a central axis extending therethrough, and an opening, said opening of said second passage being provided in said groove of said first passage to allow fluidic communication between said second passage and said first passage.

17. The common rail of claim 16, wherein said groove peripherally circumscribes at least a portion of said first passage.

18. The common rail of claim 17, wherein said groove partially circumscribes said first passage and is crescent shaped.

19. The common rail of claim 17, wherein said first passage is substantially circular in cross section and said groove is annular in shape, said groove having a groove diameter larger than said first diameter of said first passage.

20. The common rail of claim 16, wherein said groove has a dished curvature.

21. The common rail of claim 16, wherein said opening of said second passage is transversely offset in said groove so that said central axis of said second passage does not intersect said longitudinal axis of said first passage.

22. The common rail of claim 16, wherein said second passage is at least two second passages, each having an opening that is positioned in said groove.

23. The common rail of claim 22, wherein said at least two second passages are transversely offset in said groove.

24. The common rail of claim 23, wherein said at least two second passages are positioned in said groove opposite to one another.

25. The common rail of claim 16, wherein said common rail is made of an alloy steel comprising at least one of chromium, molybdenum, and vanadium.

26. The common rail of claim 25, wherein said alloy steel comprises by weight, up to 5.5% chromium, up to 1.5% molybdenum, and up to 1.0% vanadium.

27. The common rail of claim 25, wherein said alloy steel is treated through a heat treatment cycle to provide a hardened martensitic core.

28. The common rail of claim 25, wherein said alloy steel is gas nitrided to provide a surface with enriched nitrogen content and hard surface layer having residual compressive stresses.

29. A high pressure fuel pump for providing high pressure fuel to a fuel injector of an internal combustion engine, said high pressure fuel pump comprising:

a fuel pump body;

a first passage formed in said fuel pump body, said first passage having a first diameter and a longitudinal axis extending therethrough, said first passage including a groove positioned along a portion of said longitudinal axis of said first passage; and

a second passage formed in said fuel pump body, said second passage having a second diameter, a central axis extending therethrough, and an opening, said opening of said second passage being provided in said groove of said first passage to allow fluidic communication between said second passage and said first passage.

30. The high pressure fuel pump of claim 29, wherein said groove peripherally circumscribes at least a portion of said first passage.

31. The high pressure fuel pump of claim 30, wherein said groove partially circumscribes said first passage and is crescent shaped.

32. The high pressure fuel pump of claim 30, wherein said first passage is substantially circular in cross section and said groove is annular in shape, said groove having a groove diameter larger than said first diameter of said first passage.

33. The high pressure fuel pump of claim 29, wherein said groove has a dished curvature.

34. The high pressure fuel pump of claim 29, wherein said opening of said second passage is transversely offset in said groove so that said central axis of said second passage does not intersect said longitudinal axis of said first passage.

35. The high pressure fuel pump of claim 29, wherein said second passage is at least two second passages, each having an opening that is positioned in said groove.

36. The high pressure fuel pump of claim 35, wherein said at least two second passages are transversely offset in said groove.

37. The high pressure fuel pump of claim 35, wherein said at least two second passages are positioned in said groove opposite to one another.

38. The high pressure fuel pump of claim 29, wherein said first passage and said second passage are made of an alloy steel comprising at least one of chromium, molybdenum, and vanadium.

39. The high pressure fuel pump of claim 38, wherein said alloy steel is treated through a heat treatment cycle to provide a hardened martensitic core.

40. The high pressure fuel pump of claim 38, wherein said alloy steel is gas nitrided to provide a surface with enriched nitrogen content and hard surface layer having residual compressive stresses.

41. A method for increasing resistance to fatigue failure in a juncture of a high pressure fuel injection system that is adapted to change direction of fuel flow in the high pressure fuel injection system, said method comprising the steps of:

providing a body;  
providing a first passage in said body, said first passage having a longitudinal axis extending therethrough;  
providing a groove positioned along a portion of said longitudinal axis of said first passage;  
providing a second passage in said body, said second passage having an opening; and  
positioning said opening of said second passage in said groove to allow fluidic communication between said second passage and said first passage.

42. The method of claim 41, further including the step of offsetting said opening of said second passage on a circumference of said groove so that a central axis of said second passage does not intersect said longitudinal axis of said first passage.

43. The method of claim 41, further including the step of providing another second passage in said body having an opening that is also positioned in said groove.

44. The method of claim 43, further including the step of positioning said second passages transversely offset in said groove and opposite to one another.

45. The method of claim 43, further including the step of heat treating said juncture to provide a hardened martensitic core.

46. The method of claim 43, further including the step of gas nitriding said juncture to provide a surface with enriched nitrogen content and hard surface layer thereon.

47. The method of claim 43, wherein said high pressure fuel injection system includes a common rail, said juncture being provided in said common rail.

48. The method of claim 43, wherein said high pressure fuel injection system includes at least one high pressure pump, said juncture being provided in said at least one high pressure pump.